An Overview of the California Department of Transportation's (Caltrans) Efforts to Address Abandoned Underground Mines.

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The purpose of this talk is to outline the forays of Caltrans in addressing abandoned mines. The focus will be upon encounters in District 10 that includes much of the historic Mother Lode [Figure 1]. My own role is with addressing the environmental consequences of capital projects that acquire or rework abandoned mining properties, rather than the engineering concerns. What will be discussed will be the screening we are currently conducting for three projects in District 10; and will use to propose state-wide practices.

Formal policy addressing abandoned mines had been developed as far back as 1996. However, this in large part addresses right of way acquisitions from locations of ore processing. Necessary information pertinent to making appropriate decisions regarding abandoned mines are generally in the possession of three departments—design, environmental, and maintenance. The proposed screening process would place evaluation of the risk of a potential abandoned mining issue upon environmental staff—specifically hazardous materials specialists. The design engineer then has responsibility to assess whether avoidance is possible, or to consult with geotechnical.

Most geotechnical work done by Caltrans has addressed mass wasting issues; and we have just completed seismic retrofits for most of our facilities. Encounters with sinkholes are not a common problem, as the state is mostly comprised of igneous or metamorphic bedrock (Sierra Nevada, Klamath-Trinities, Coast Ranges), or unconsolidated sediments (Central Valley, Los Angeles Basin); and limestone or karst is seldom encountered within the state transportation system.

The prominent mining activity in the state was for gold. Placer mining began in Los Angeles near Placerita Canyon near Newhall several years before the discovery at Sutter's Mill. Placer mining shifted over to the more efficient hydraulic mining in locales when surface water resources were plentiful and available year round. Columbia in Tuolumne County is an example of an early hydraulic mining operation. Hydraulic mining, reached its highest development on tributaries of the Sacramento River, was for all intents shutdown with the Sawyer Decision in the 1880's. Passage of the Caminetti Act (1892) allowed resumption of hydraulic mining under the regulation of the Army Corps of Engineers. Mining concerns in areas with little rainfall, or lacking the resources to construct the tailings dams required by the Corps, undertook drift mining of tertiary river deposits.

Hardrock or quartz mining had its beginnings in Mariposa and Amador Counties. Though generally not as remunerative as placer mining in the 19th Century, hardrock mining's success was limited by lack of geologic knowledge and engineering advances; and, constrained by California isolation from industrial centers. By the start of the 20th Century, several hard rock mines were reconditioned and paying dividends.

The likelihood to encounter abandoned mines upon state highway routes in California is unknown. In District 10 the likelihood is considered high anywhere in Amador, Alpine, Calaveras, Tuolumne, and Mariposa counties; moderate in eastern Merced and Stanislaus Counties, and low in San Joaquin and western Merced Counties. Highly discriminate mapping of abandoned mine sensitivity (e.g. mine name, material mined, extent of operations, etc.) needs to be performed, if only to ensure that abandoned mining concerns are considered during project design.

The examples below represent three current projects that illustrate various challenges abandoned mines present to project design. I am directly involved in two (Jackson Widening and Clinton Road Signals), but have been provided information relating to the third by the design engineer (Angels Camp Bypass).

1.) The Jackson Widening is a proposed widening of a non-standard highway to current shoulder widths. The current alignment evolved since 1935 from a road specifically constructed to access three quartz gold mines—the Kennedy, the Argonaut, and the Muldoon ---that all appear to work the same vein. The segment is noteworthy for the ready view of three head frames or hoists associated with these mines. The highway proceeds in a direction orthogonal (340 ^{o}) to the reported strike of the gold vein (20^{o}, with a 70^{o} E dip). The Kennedy is reported to have three shafts, the eastern-most, sunk in 1900 reached at depth of 5912 feet, is well away from the current alignment, and is probably not representative of conditions beneath the highway. The South shaft extended to a depth 2,500 feet beneath the surface by 1899 (Figure 2). The south shaft was acquired and "obliterated" by Caltrans in 1958.

The positioning of the Kennedy shafts indicated subsurface voids would extend away from the highway segment, and would not be present beneath it. However, there are records of a legal dispute from the 1920s between the Kennedy Mine and the Argonaut Mine when the workings of the two interconnected. (which was also the setting of the disastrous mine fire in the 1922 at the 3,300 foot level that spread into the Kennedy Mine workings) Further, it is unclear the extent of the obliteration performed on the South shaft, which was on the edge of past right of way, but will now be brought to where it will be beneath pavement.

The Mill Tunnel was excavated and backfilled as an extra work order during the 1935 conversion of the Sutter Creek-Ione Road to State Highway 34. The two tunnels that branch from the Muldoon (the collar is 35 feet lower than the original road surface) do not appear to have been addressed. Mapping indicates that the Muldoon shaft is outside current right of way.

2.) The Angels Camp Bypass is the proposed construction of new highway that bypasses to the north and east around Angels Camp. The new alignment begins in the Mother Lode Belt, and transects areas where the predominant activity was placer and hydraulic mining, with a shift to drift mining associated with tertiary river channels. The proposed alignment transects the Calaveras Central Drift Mine, a consolidation of the Victor, McElroy, Aetna, and Calmo drift mines. The two shafts that were employed in operating the Calaveras Central Mine were the 300 foot deep Victor Mine and the 240 foot deep Aetna Shaft. The Aetna, the Calmo and the McElroy Shafts occur in locations adjacent to the new alignment. However, development of the tertiary gravel bed by the Calaveras Central did not include the McElroy that had sunk a 200 foot shaft prior to 1900.

Screening also identified a Mattison Mine, a Starve Out Mine, and a Mike Brown Mine for which no production records appear available. The Mattison Mine appears upon a USGS Quadrangle near the location for the McElroy Mine; while the other two appear in a Calaveras County GIS mines layer. The locations of the Starve Out and Mike Brown Mines are located SE from the tertiary river channel, but do not reach the Mother Lode belt.

The precise mapping of three channels of tertiary gravel deposits attest to extensive mine development. "Most of the underground drifts have a cross section of 6-7 feet and require little or no timbering. (CDMG, 1963, p. 86)" This area appears avoided by the current proposed alignment.

Design has already identified locations for the McElroy shaft, and a tunnel associated with the Calaveras Central Drift Mine not identified in any reports reviewed by myself. At these locations, the alignment is likely to encounter subsurface voids. Geotechnical has already evaluated the segment crossing the tunnel as a location given to an unspecified rate of subsidence, but the final evaluation or determination of a design solution has not been offered.

There is some ambiguity at the western limit of the project. New right of way is associated with a Jolly Tar mining claim. The Jolly Tar is associated with the Fazzi Mine as a possible synonym, and is the name used by Caltrans for source of mine tailings borrowed as fill for a 1958 highway project. The Jolly Tar is reported as a speculative land venture in a 1933 Mines and Minerals Report. The Fazzi Mine (developed in 1921) is mapped as away from the proposed alignment, appears to have been a serious mining venture (it had a stamp mill and Frue vanners), and should not affect the project if the only shaft. The shaft is developed on two levels, and to a depth of 300 feet, and may be present beneath the proposed alignment.

3.) Clinton Road Signal is the construction of traffic signals at an intersection with State Route 49 near Jackson. Direct soil disturbance by the project is minor—trenches three to four feet deep, and excavation for the signals to possibly ten feet. Sewer drains were installed running parallel to the shoulders on the eastern edge of the highway. Review of the historic highway as built plans indicated that three mine shafts were abandoned with the construction. The location of the shafts conformed to the center line of the highway,

suggesting that any working levels might not have been encountered by the installation of the drains. The South Jackson Mine consisted of a 577 foot vertical shaft, with 2,100 foot underground workings. Just to the east is the Ziele Mine, the underground workings of which are more complex. The mine portal (closed) appears to head in a southwesterly direction however, the vein is reported to strike north and south, with an eastward dip. The shaft is inclined at 65^{o} for a length of 1700 ft. At the 1,570 foot level, a 3,000 foot long drift was driven northward along the vein, terminating in a 458 foot deep winze. A second drift was driven from the shaft along the vein to the winze.

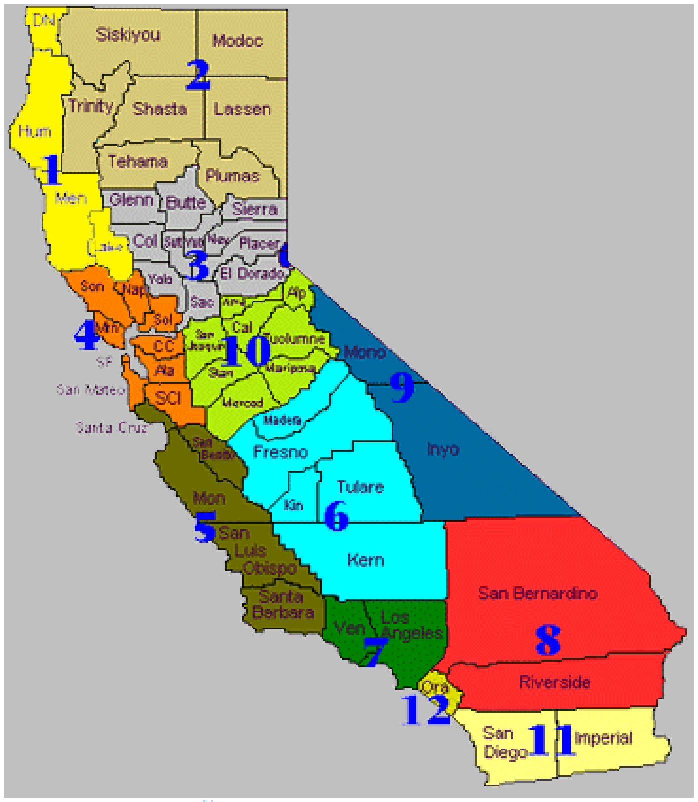
Conclusions:

Jackson Widening: The mapping of subsurface features give strong indication that voids beneath the highway are present. The Muldoon Tunnels may be easily accessed for abandonment; however deeper working levels of the Kennedy and Argonaut Mines pose serious problems.

Angels Camp Bypass: At one time mapping of the Calaveras Central Drift Mine was made available to the project designer, who when presented with it could not make out the information it contained, nor allowed to make a copy. Fortunately, drift mines usually have only one working level (through three are present at this site) that runs roughly parallel to the surface. Subsidence problems have been identified. The location of the Fazzi (Jolly Tar) mine still needs resolution, and will need to be addressed visiting the County archives that are currently unavailable.

Clinton Road Signal: The Ziele Mine does not appear to approach the project area, and would not be cause for concern. Mapping of the South Jackson Mines may be available from the Amador County Archives, which when last consulted were moving to a new location, and were inaccessible. There still exists a concern, but it is probably beyond the scope of the project to address, if the working levels of the mine are inaccessible by excavation.

The effort involved in screening potential abandoned mine problems is considerable, and can only be lessened with familiarity with the sources of information. Although this discussion is short, it reflects two years of effort—almost all of it directed to the Jackson Widening.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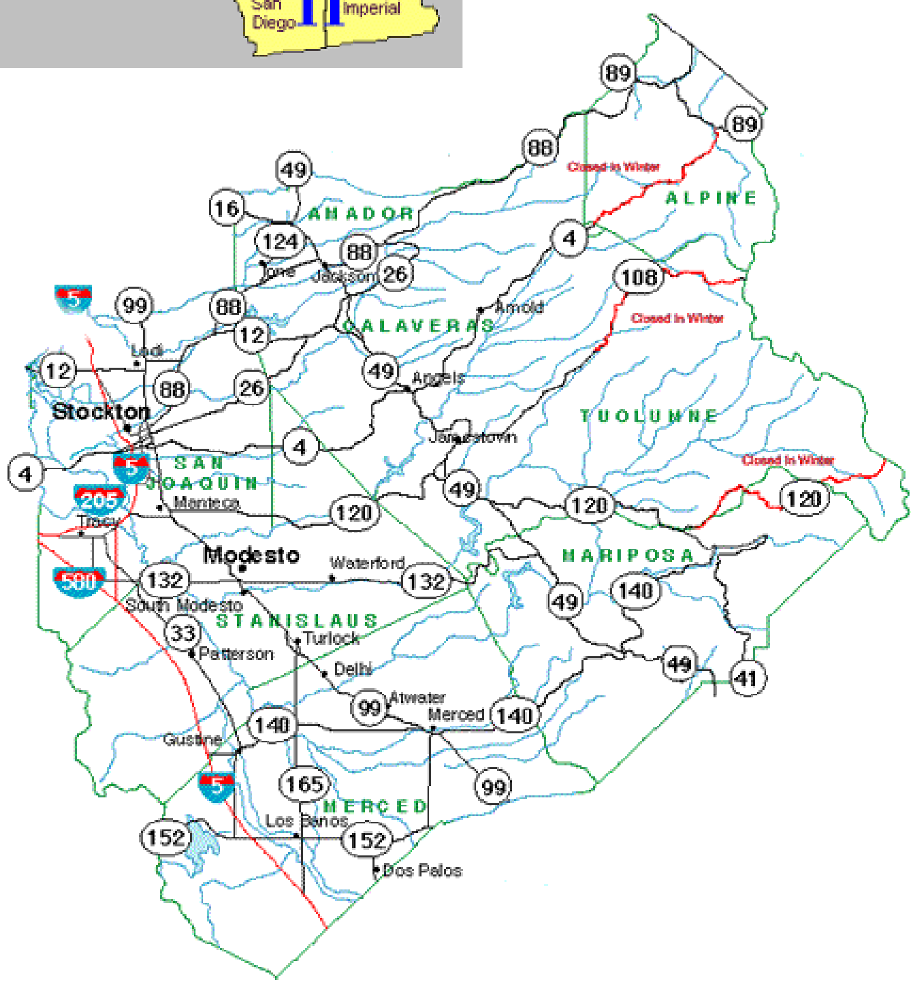
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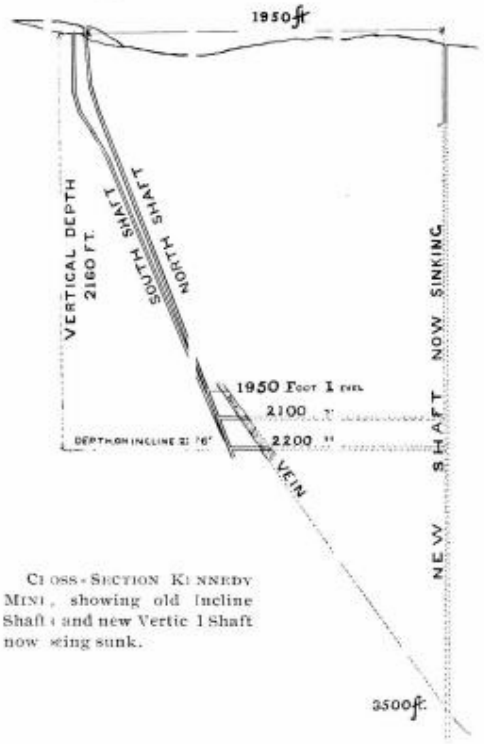

CROSS-SECTION KENNEDY MINE, showing old Incline Shafts and new Vertical Shaft now being sunk.

Kennedy Mine Cross-Section (1899)